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TESTS ON SOILS SAMPLES FROM OVERSEAS
AIR BASES

Army Engineer Waterways Experiment Station
Vicksburg, Mississippi

April 1949

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CORPS OF ENGINEERS
U. S. ARMY

TESTS ON SOILS SAMPLES FROM
OVERSEAS AIR BASES

TECHNICAL MEMORANDUM NO. 1-274

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WATERWAYS EXPERIMENT STATION

VICKSBURG, MISSISSIPPI

FOR

OFFICE OF THE CHIEF OF ENGINEERS

AIRFIELDS BRANCH

ENGINEERING DIVISION

MILITARY CONSTRUCTION

APRIL 1964

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classified "Secret" and
is to be controlled
accordingly.

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I

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TESTS ON SOIL SAMPLES FROM OVERSEAS AIR BASES

Introduction

1. Collection and shipment of 50-lb soil samples, representative of soils at overseas airfields, was directed by letter from Headquarters, Army Air Forces, Washington, D. C., to all Theatre Commanders, subject: "Soil Samples," and dated 26 September 1945. The procedure to be followed in selecting and shipping the samples was outlined in a subsequent letter, same subject, dated 31 October 1945. In this letter layout maps showing sample location were requested, together with any available soil test data. A third letter, dated 31 October 1945, from Headquarters, Army Air Forces, to Theatre Commanders, subject: "Soil Samples," requested data on runways (descriptions of pavements, base courses, types of using planes, frequency of operation) and evaluation of performance of the airfield.

2. It was directed in these letters that the soil samples and all pertinent correspondence be sent to the Commanding General, 463rd AAF Base Unit, Geiger Field, Washington, where it was intended that the testing of the samples should be done by the soils laboratory operated by the Aviation Engineer Training School. However, due to the reduction of personnel and facilities at Geiger Field resulting from demobilization processes, arrangements were made by the Office of the Air Engineer, Army Air Forces, Washington, D. C., through the Office, Chief of Engineers, to have the samples and data transferred to the Waterways Experiment Station for necessary testing, analyzing, documenting and storing.

3. Direct authorization for the work by the Waterways Experiment

Station was contained in the 5th indorsement, dated 19 March 1946, from the Office, Chief of Engineers, to the President, Mississippi River Commission, to basic letter dated 4 February 1946, subject: "Analysis of Soil Samples," from the Office, Air Engineer, Army Air Forces, Washington, D. C., to the Chief of Engineers, U. S. Army.

4. The Instructions and Outlines for Testing Soil Samples from Overseas Air Bases, Office, Chief of Engineers, dated October 1946, defined the scope and objectives of the project as follows:

"Scope: 3. This project consists of the performance of mechanical analyses, Atterberg limits, specific gravity, Proctor compaction, and California Bearing Ratio tests on each sample received from overseas air bases.

"Objectives: 4. The purpose of this project is to accumulate information and data concerning soil conditions in overseas theatres."

Soil Samples

5. A total of 551 samples from 222 overseas air bases were received, identified, and tested by the Waterways Experiment Station. Correspondence indicated that samples were shipped from 20 additional air bases, but these samples were either lost en route, or had insufficient markings to be identified when received at the Waterways Experiment Station.

6. The airfields from which samples were received are listed geographically in five main groups as shown in table 1; this grouping and the order within each group have been retained in reporting the soils test data.

7. Table 2 shows the breakdown of the soil samples according to sample sizes by weight. It will be noted that the instructions to ship 50-lb samples must have been misconstrued in many instances, because one-half of the samples were less than 30 lb, and one-quarter less than 15 lb. Of the samples larger than 40 lb, those from Italy and the Philippines comprised 70%, the remaining 30% being scattered among the other reporting theatres.

8. It is therefore apparent that limitations were set by the sizes of the samples on the number of compaction and CBR tests which could be performed, and also on the methods of performing such tests without excessive reuse of the materials.

9. In many cases little or no data were furnished with the soil samples concerning their location and depth at the airfield, whether representative of paving aggregate, base course, subgrade or fill. A similar lack of information existed concerning the air fields: type and thickness of pavement and base course, preparation of subgrade; types of using planes; extent of use; performance of the airfield, et cetera.

10. It should be noted that in many cases it appeared that the soils were sampled by non-engineering types of army units, who were not familiar with details of the construction of the fields represented, nor had acquired the techniques and experience necessary to secure representative soil samples.

11. Particular mention is made of the very comprehensive and well-planned survey in connection with the soil sampling carried out by the Investigations Branch of the General Engineer District, APO 75, covering fields in the Philippines and several other Pacific islands. It is

4

unfortunate that similar surveys of the other overseas air bases reported were not made.

Furnished Data on Theatre Soils Tests and Surveys,
and other Pertinent Subjects

12. Supplementary data consisting of soils tests, soil surveys, geological reports, etc., were furnished in various amounts by the following theatres only:

Group B	- - - - -	Italy
Group C	- - - - -	Africa
Group D	- - - - -	India and Burma
Group D	- - - - -	China
Group E	- - - - -	Philippines
Group F	- - - - -	Alaska

13. Such data, other than those pertaining to airfield description, have not been incorporated in this report, as they are beyond the scope of the project directive. These memoranda, letters, and reports are forwarded as inclosures, as listed on the sheets following the text of this report.

Waterways Experiment Station Soils Tests

14. Summaries of all test results are presented in table 3 together with pertinent airfield data and sample descriptions. The following paragraphs are explanations of terms of data shown in this table, and descriptions of testing methods used.

Field classification

15. The source of information for this column was the AAF Installations Directory, 15 March 1946, Headquarters AAF, Washington,

D. C. (Confidential). The following abbreviations are used:

F = fighter
 FB = fighter bomber
 MB = medium bomber
 HB = heavy bomber
 VHB = very heavy bomber
 T = transport
 HT = heavy transport
 M = classified by AAF as minor airfield because either used only a short time by tactical units, or constructed or improved at over-all cost to the U. S. of less than \$25,000.

Airfield description

16. This column includes data on type of surface, base course, subgrade, and pertinent information on operation, use, and general condition of the field. The following abbreviations are used in this column:

FSP = pierced steel plank
 PAP = pierced aluminum plank
 PBS = prefabricated bituminous surfacing.

Location

17. As previously mentioned, the information obtained identifying the location of samples was, in many instances, incomplete. However, this column indicates the location at the airfields from which the samples were taken insofar as data were available.

Material

18. This column includes data, where available, on the type of material sampled, such as base course, subgrade, etc. In some instances the depth of sample or thickness of layer are also shown in this column.

Description

19. The sample description includes the color and an appropriate name classification derived from the soil triangle of the Department of the Army Uniform Soil Classification System. The name of a soil is based on both gradation and plasticity characteristics. A copy of the soil triangle is shown on figure 1, together with notes explaining its use. Distinctive soil types such as tuff, volcanic ash, coral, etc., where so identified, are described as such.

Classification symbol

20. The soils were also classified using group symbols of the Department of the Army Uniform Soil Classification System. This system is based upon the one developed by A. Casagrande which was used extensively during World War II as the "Airfield Classification." Pertinent features of the presently used system are shown on figure 2.

Grain sizes

21. The division of grain sizes into major soil types is in accordance with the Department of the Army Uniform Soil Classification. Pertinent size ranges for each group are shown in the column headings; sieve sizes are U. S. Standard. The sand sizes have been broken down into "coarse" and "fine" fractions as an aid in evaluating the gradation of the various soils. Where an appreciable percentage of gravel sizes is present in a sample, the maximum size in inches is also shown.

Atterberg limits

22. Values reported are liquid limit (LL) and plasticity index

(PI). The limits tests were performed on that portion of the soil sample passing the No. 40 U. S. Standard sieve.

Specific gravity

23. The specific gravity tests were performed on that portion of a soil sample passing the No. 4 U. S. Standard sieve. The test was performed in a volumetric flask and air was evacuated by subjecting the soil and water to a vacuum.

Modified AASHTO compaction tests

24. Because of the small quantity of material available for testing, all compaction tests were performed using the standard Proctor mold. The soil sample ($< 1/4$ in.) was compacted in five layers with 25 blows on each layer produced by free fall of 18 in. of a 10-lb hammer with a 2-in.-diameter striking face. The optimum water content (w in per cent of dry weight) and the maximum dry density (γ_d) under the above conditions are shown in the table.

CBR tests

25. Because of the small quantity of each sample available (rarely more than 50 lb) the standard procedures for conducting the CBR tests* could not be followed entirely; however, the values reported are believed reasonable as discussed below. All specimens were soaked four days top

* TB5-253-1, "Soil Testing Set No. 1 and Expedient Tests," War Department, June 1945, and T.M. 213-1, "The California Bearing Ratio Test as Applied to the Design of Flexible Pavements for Airports," Waterways Experiment Station, 1 July 1947.

and bottom. The penetration test was performed using a Baldwin-Southwark constant strain testing machine. A uniform surcharge load of 10 lb was applied to each specimen during the soaking and penetration testing.

26. The values reported in the CBR column of table 3 represent the CBR of coarse-grained soils compacted to 100% of modified AASHTO maximum density and the CBR of fine-grained soils compacted to 95% of modified AASHTO maximum density, and at the optimum moisture content for modified AASHTO compaction. These densities are in accordance with design procedures for airfields currently used by the Corps of Engineers as shown in Chapter XII, Part 2 of the Engineering Manual. The CBR values are based on test data, but have in some cases been adjusted to compensate for variations in density and moisture content in the test from the standards listed above. Adjustment has also been made to compensate for variations from the standard procedure for conducting the CBR test. The adjustments are believed reasonable since they are based upon a considerable number of CBR tests on a variety of materials performed previously by the Waterways Experiment Station in which the effect of the above-mentioned variables was investigated.

Swell

27. Values of swell were obtained for the CBR samples after 4 days soaking. In table 3 swell is reported as "low" or "high." Swell values of 3 per cent or less were classed as "low," whereas values over 3 per cent were classed as "high."

REPORTS AND OTHER DATA FURNISHED IN CONNECTION WITH
SOIL SAMPLES FROM OVERSEAS AIR BASES

Group B: Italy:

Incl. 1. Airfield Status Report 15 July 1945, Hq AAF Engr. Command,
MFO

Group C: Africa: (French Airfield Survey Reports)

(a) Algeria

Incl 1. Blida
Incl 2. La Reghaia
Incl 3. Bougie
Incl 4. Djidjelli
Incl 5. Taher
Incl 6. Philippoville
Incl 7. Bone
Incl 8. Biskra
Incl 9. Navarin
Incl 10. St. Donat
Incl 11. Chateaudun du Rhumel
Incl 12. Timeslet
Incl 13. Telergha
Incl 14. Bertaux No. 1
Incl 15. Bertaux No. 2
Incl 16. Ain M'Lila
Incl 17. Le Kroub
Incl 18. Canrobert
Incl 19. Montesquieu
Incl 20. Tebessa

(b) Laghouat

Incl 21. Laghouat

Group D: India and Burma; China:

Part 1. Furnished by theatre:

Incl. 1 - Ltr, Hq AAF-IBT, dated 22 October 1945, subject:
"Soil Samples."
Incl. 2 - Booklet, "USAAF Airfields, 'ia-Burma," Office
of the Air Engineer CBI- (in dupl.).
Incl. 3 - "Airfield Status Map," IB-AS, Office of the Air
Engineer, 15 April 1945.
Incl. 4 - Geological Report, Midnapore District, 15
November 1944.

- Incl. 5 - Ltr, Hq SOS, USF, CBI, dated 24 February 1944, subject: "Design of VLR Fields."
- Incl. 6 - Memo to District Engr, Engr Dist #10, 1 April 1944, subject: "Test Section using Moorun Base."
- Incl. 7 - Ltr, Engr Dist #10, dated 4 May 1944, subject: "Subgrade Tests."
- Incl. 8 - Memo to Chief Engineer, L of C Command, dated 4 January 1945, subject: "Tests - Elephant (Maugdaw) and Teknaf Airfield Sites."
- Incl. 9 - Memo to Chief Engineer, 14th Army, dated 25 October 1944, subject: "Tests - Cox's Bazaar Airfield."
- Incl. 10 - Memo to Chief Engineer, L of C Command, dated 12 December 1944, subject: "Tests on Soil Cement, Chir'nga Airfield."
- Incl. 11 - Ltr, Hq IB-ACS, dated 5 February 1945, subject: "Soil Reconnaissance Proposed Kyaukpyu Airfield."
- Incl. 12 - Memo, Hq IB-ACS, 10 April 1945, subject: "Soil Reconnaissance - Airfield Sites on Akyab Island."
- Incl. 13 - Memo, Hq IB-ACS, 10 April 1945, subject: "Hathazari Airfield."
- Incl. 14 - Memo, Hq IB-ACS, 24 June 1945, subject: "Airfields in the Rangoon Area."
- Incl. 15 - Memo, Hq IB-ACS, 15 August 1945, subject: "Soils Tests-Myingyan Airfield, Burma."
- Incl. 16 - Memo, Hq IB-ACS, 31 May 1945, subject: "Soils Tests-Shwobo and Onbauk Airfields."
- Incl. 17 - Ltr, Engr Dist #10, 6 March 1944, subject: "Tests on Concrete Aggregates."

Part 2. Furnished by Office of Air Engineer, AAF, Washington, D.C.:

- Incl. A - "Final Report, B-29 Air Bases - India," Construction Service SOS USAF, CBI, November 1944 (Restricted).
- Incl. B - "Construction of Airfields in North Burma," Air Engineer, ASF, IB 15 July 1945 (Restricted).
- Incl. C - "Survey of Burma (Extract)," Command and General Staff School, Fort Leavenworth, Kansas (Restricted).

Part 3.

- Incl. 1 - Soil Tests - Linan Airfield.
- Incl. 2 - Soil Tests - Mengtze Airfield.
- Incl. 3 - Soil Tests - Tatum #1 Airfield.
- Incl. 4 - Soil Tests - Tatum (Chacopa) Airfield.

Part 4.

- Incl. A - List of soil samples sent.
- Incl. B - Map showing location of airfields.
- Incl. C - Soils Survey - Chanyi Airfield.
- Incl. D - Soils Tests - Hsinching Area.
- Incl. E - Soils Survey - Luliang Airfield.
- Incl. F - Supplementary Airfield Data.

Group E: Philippine and Other Pacific Islands:Part 1. Airfield and Sample Data on Fields from Which Samples Were Forwarded:

- Incl. 1 - Luzon Island (in dupl).
- Incl. 2 - Mindoro Island.
- Incl. 3 - Leyte, Samar, Cebu, Negros, and Mactan Islands (in dupl).
- Incl. 4 - Mindanao, Palawan, Palau, Batak, and Los Negros Islands (in dupl).

Part 2. Various Reports on Airfields in the Philippine Islands:

- Incl. P-2-a-(1): Soils Report on Nichols Field, NW-SE Runway and Taxiway, 8 April 1945.
- Incl. P-2-b-(1): Specifications for Construction of Neilson Airdrome, 15 April 1945.
- Incl. P-2-c-(1): Report on Evaluation of Clark Field, Florida Blanca and Porac Airdromes, 5 August 1945 (Inclosure missing).
- Incl. P-2-c-(2): Photographic Report for March 1945. Clark Field Engr Area.
- Incl. P-2-d-(1): Soil Profile, Proposed Taxiway, Florida Blanca Airdrome, June 1945.
- Incl. P-2-d-(2): Operational Photos, Florida Blanca Airfield, 1 July 1945.
- Incl. P-2-d-(3): Operational Photos, Florida Blanca Airfield, 1 September 1945.
- Incl. P-2-d-(4): Specification for Double Asphalt Surface Treatment, Florida Blanca and Porac Airfields, 21 April 1945.
- Incl. P-2-e-(1): Soils Investigation of C-47 Strip at San Fernando, La Union, 8 November 1945 (Inclosure missing).
- Incl. P-2-e-(3): Photographic Report, Lingayen Area, February 1945.
- Incl. P-2-e-(4): Photographic Report, Lingayen Area, March 1945.

Group F: Alaska:

Incl. 1 - Stabilization of Beach Gravel for Runway Construction at Point Spencer, Alaska, 31 August 1945 (Restricted).

TABLE 1

GEOGRAPHICAL BREAKDOWN OF FIELDS AT WHICH SOIL SAMPLES WERE TAKEN

Group	Subgroup		Total Fields in Group
	Country or Island	No. Fields	
A. Germany, Austria and France	(1) Germany	19	21
	(2) Austria	1	
	(3) France	1	
B. Italy			43 (2)
C. Africa	(1) Rio de Oro	1	(1) 77 (4)
	(2) French Morocco	3	
	(3) Algeria:		
	(a) Oran area	6 (1)	
	(b) Algiers area	2 (1)	
	(c) Constantine area	20	
	(d) Ghardaia area	1	
	(e) Tougourt area	1	
	(4) Tunisia	28 (2)	
	(5) Libya	1	
	(6) French West Africa	1	
	(7) Gold Coast	2	
	(8) French Equatorial Africa	1	
D. Near East, India, Burma, and China	(9) Belgian Congo	2	
	(10) Nigeria	3	
	(11) Anglo-Egyptian Sudan	3	
	(12) Eritrea	2	
	(13) Egypt		
	(1) Near East:		
	(a) Turkey	2	
	(b) Syria (Lebanon)	1	
	(c) Palestine	1	
	(d) Iraq	1	
	(e) Iran	1	
	(f) Saudi Arabia	4	
	(2) India:		
	(a) United Provinces	1	
	(b) Bombay	1	
	(c) Bengal	9 (1)	
	(d) Assam	1 (1)	
	(e) Mysore	1 (1)	
	(3) Burma:	4	
	(4) China:		
	(a) Shensi Province	3	

() = Samples from fields either lost enroute or unidentified.

TABLE 1 (Cont.)

GEOGRAPHICAL BREAKDOWN OF FIELDS AT WHICH SOIL SAMPLES WERE TAKEN

Group	Subgroup		Total Fields in Group
	Country or Island	No. Fields	
	(b) Szechwan Province	4 (1)	
	(c) Hunan Province	2	
	(d) Kweichow Province	3	
	(e) Yunnan Province	2	
	(f) Kwangsi Province	2	16 (1) 42 (4)
<u>Pacific Islands:</u>			
E. Philippine, Palau and Admiralty Islands; and New Guinea Area	(1) Philippine Islands:		
	(a) Luzon	9	
	(b) Mindoro	4	
	(c) Palawan	1	
	(d) Negros	1	
	(e) Cebu	2	
	(f) Loyte	4	
	(g) Samar	1	
	(h) Mindanao	2	24
	(2) Palau Group - Peleliu	1	
	(3) Admiralty Islands - Los Negros	1	
	(4) New Guinea Area - Biak	1	27
F. Hawaiian Islands, Alaska, and Aleutian Islands	(1) Hawaiian Islands (Oahu)	3	
	(2) Alaska	6 (9)	
	(3) Aleutian Islands:		
	(a) Umnak	1	
	(b) Atka	1	
	(c) Adak	1	
	(d) Shemya	(1) 3 (1)	12 (10)
TOTALS			222 (20)

() = Samples from fields either lost enroute or unidentified.

TABLE 2
BREAKDOWN OF SAMPLES ACCORDING TO SAMPLE SIZE

<u>Geographical Group</u>	<u>10-15 Lb</u>	<u>20-30 Lb</u>	<u>40-50 Lb</u>	<u>Over 50 Lb</u>	<u>Total Number</u>
Group A: Germany	5	31	12	2	50
Austria	1	-	-	-	1
France	-	3	6	-	9
Group B: Italy	-	-	124	-	124
Group C: Africa: Algeria	73	15	-	-	88
Tunisia	21	8	19	1	49
Others	27	5	10	5	47
Group D: Near East	-	6	6	5	17
India	-	20	6	-	26
Burma	-	12	-	-	12
China	5	9	2	-	16
Group E: Philippine Islands	-	-	49	18	67
Other Pacific Islands	-	-	2	1	3
Group F: Hawaiian Islands (Oahu)	-	10	-	-	10
Alaska and Aleutian Islands	-	27	5	-	32
TOTALS	132	146	241	32	551

SAMPLE

TESTS:

The subgrade is a course to be laid about 100 feet from the west end of the runway. It extends about 1000 feet from the west end of the runway. The subgrade is a course to

TABLE 3: SUMMARY OF AIRFIELD TEST DATA (CONCL.)

[illegible]

Notes: This is one of the best fields in Germany. The topsoil sample is not the subgrade material under the runway.

TABLE 3: SUMMARY OF AIRFIELD TEST DATA (Cont.)

Group B: Italy

Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classi- fication	SAMPLE										SOIL TESTS		
								Max. Gravel Size >No. 10 In.	Gravel % by Weight	Grain Sizes			Fines No. 200 <No. 100 % by Weight	Atterberg Limits	Plasticity Index	Moist. Shrinkage Coefficient	Opt. Moist. % at 23°C	Liquid Limit % at 23°C	Shrinkage Ratio	Dry Density pcf
										Coarse >No. 10 to No. 20 % by Weight	Medium No. 20 to No. 60 % by Weight	Fine No. 60 to No. 200 % by Weight								
Bologna	44 32 N 11 15 E	F	Surface: Turf	-	Subgrade	Brown sandy clay	CL	1-1/2	100	0	1	99	60	35	22	-	-	-	-	-
Bavignone	44 41 N 11 44 E	M	Surface: Turf Base: None	-	Base course	Brown medium gravel	GP	1-1/2	100	0	0	0	0	35	22	-	-	-	-	-
Forlì	44 12 N 12 06 E	M	Surface: Turf Base: None	-	Base course	Brown sandy gravel	GP	1-1/2	77	15	6	2	6	34	15	-	-	-	-	-
Cremona	45 13 N 10 23 E	M	Surface: P/P Base: None	-	Subgrade	Brown sandy clay	CL	-	0	2	30	68	0	-	-	-	-	-	-	-
Parma	45 01 N 10 37 E	M	Surface: P/P Base: Gravel	-	Subgrade	Clay, fine sand	SM	-	0	0	94	14	85	-	-	-	-	-	-	-
Castellina	43 48 N 12 41 E	M	Surface: P/P	-	Subgrade	Gray sandy clay	CL	-	0	3	22	75	42	22	-	-	-	-	-	-
Pavia	45 40 N 13 01 E	M	Surface: P/P Base: Gravel	-	Subgrade	Gray medium gravel	GP	1-1/2	69	3	6	2	4	85	-	-	-	-	-	-
Pragaglia	43 43 N 13 09 E	F	Surface: P/P Base: Gravel	-	Subgrade	Gray coarse to fine gravel	GP	1-1/2	69	7	6	2	4	85	-	-	-	-	-	-
Montalbano	43 45 N 13 09 E	M	Surface: P/P Base: Gravel	-	Subgrade	Brown clay	CH	-	0	4	4	0	94	52	34	-	-	-	-	-
Palcomare	43 37 N 13 22 E	M	Surface: P/P Base: Gravel	-	Subgrade	Medium gravel	GP	1-1/2	100	0	0	0	0	85	-	-	-	-	-	-
Imola	43 32 N 13 16 E	M	Surface: Turf Base: Gravel	-	Subgrade	Medium gravel	GP	1-1/2	100	0	0	0	0	85	-	-	-	-	-	-
Trapani	42 08 N 12 46 E	M	Landing strip	-	Subgrade	Clay	CL	-	1	3	2	94	49	25	-	-	-	-	-	-
Catania	42 03 N 14 49 E	M	Landing strip	-	Subgrade	Medium gravel	GP	1-1/2	94	2	0	0	0	85	-	-	-	-	-	-
Milano	45 40 N 12 03 E	M	Surface: P/P runway and taxiway	-	Subgrade	Medium gravel	GP	1-1/2	94	2	0	0	0	85	-	-	-	-	-	-
Montebelluna	45 24 N 12 01 E	F	No information	-	Subgrade	Medium gravel	GP	1-1/2	100	0	0	0	0	85	-	-	-	-	-	-
Cuneo	45 26 N 12 06 E	F	Surface: P/P and brick runway. P/P on gravel taxiway	-	Subgrade	Medium gravel	GP	1-1/2	100	0	0	0	0	85	-	-	-	-	-	-
Medan	45 25 N 12 09 E	F	No information	-	Subgrade	Medium gravel	GP	1-1/2	100	0	0	0	0	85	-	-	-	-	-	-
Genoa	44 52 N 12 19 E	F	Surface: P/P runway and taxiway	-	Subgrade	Medium gravel	GP	1-1/2	100	0	0	0	0	85	-	-	-	-	-	-

TABLE 31. SUMMARY OF ADJUSTED TEST DATA (Cont.)

Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Class. (Symbol)	Grain Size										Moist. AA 50		
								No.	Grain Size	No.	Grain Size	No.	Grain Size	No.	Grain Size	No.	Grain Size	No.	Grain Size	No.
San Severo	41 53 N 15 26 E	1B	Surface: Runway - gravel, oiled Taxiway - gravel Landing strip - gravel	Runway East taxiway West taxiway	- - -	Brown sandy clay Brown sandy clay Brown sandy clay	CL CL CL	0	1	1	1	1	1	1	1	1	1	1	1	1
Starpurone	41 56 N 15 17 E	1B	Surface: Landing strip - oiled Taxiway - gravel, oiled	North taxiway South taxiway	3 ft depth 3-1/2 ft depth	Brown clay Brown clay	CL CL	0	1	1	1	1	1	1	1	1	1	1	1	1
Saliceta	41 33 N 15 27 E	1B	No information	Runway Taxiway	2 ft depth 2 ft depth	Brown clay Brown clay	CL CL	0	1	1	1	1	1	1	1	1	1	1	1	1
Trivello	41 37 N 15 27 E	1B	Surface: Oiled landing strip	Runway Landing strip South taxiway	2 ft depth 2 ft depth 2 ft depth	Brown clay Brown clay Brown clay	CL CL CL	0	1	1	1	1	1	1	1	1	1	1	1	1
Colonna	41 33 N 15 34 E	1B	Surface: ROP runway	Runway	2 ft depth	Brown clay	CL	0	1	1	1	1	1	1	1	1	1	1	1	1
Lucera	41 30 N 15 29 E	1B	Surface: Runway - ROP Taxiway - gravel, oiled	Runway Taxiway	2 ft depth 2 ft depth	Brown sandy clay Brown sandy clay	CL CL	0	1	1	1	1	1	1	1	1	1	1	1	1
Vicenza	41 29 N 15 27 E	1B	Surface: Runway - oiled Taxiway - oiled	Runway Taxiway	2 ft depth 2 ft depth	Brown sandy clay Brown sandy clay	CL CL	0	1	1	1	1	1	1	1	1	1	1	1	1
Peglia Mela	41 26 N 15 32 E	1B	Surface: Northbound runway - asphalt Southbound runway - gravel, oiled Taxiway - asphalt and gravel	Runway Runway Runway	2 ft depth 2 ft depth 2 ft depth	Brown sandy clay Brown sandy clay Brown sandy clay	CL CL CL	0	1	1	1	1	1	1	1	1	1	1	1	1
Amadola	41 33 N 15 42 E	1B	Surface: Runway and taxiway. Oiled Landing strip	Runway Taxiway	2 ft depth 2 ft depth	Brown sandy clay Brown sandy clay	CL CL	0	1	1	1	1	1	1	1	1	1	1	1	1
Tortorella	41 26 N 15 39 E	1B	Surface: 2 runways - oiled turf Taxiway - gravel	Runway Taxiway	2 ft depth 2 ft depth	Brown sandy clay Brown sandy clay	CL CL	0	1	1	1	1	1	1	1	1	1	1	1	1
Castelluccio	41 19 N 15 33 E	1B	No information	Runway Taxiway	2 ft depth 2 ft depth	Brown sandy clay Brown sandy clay	CL CL	0	1	1	1	1	1	1	1	1	1	1	1	1
Starnone	41 17 N 15 44 E	1B	Surface: Runway - gravel, oiled. North Taxiway - gravel	Runway Taxiway	2 ft depth 2 ft depth	Brown sandy clay Brown sandy clay	CL CL	0	1	1	1	1	1	1	1	1	1	1	1	1
Cicilia	41 16 N 15 30 E	1B	Surface: Runway - gravel, oiled	Runway	2 ft depth	Brown sandy clay	CL	0	1	1	1	1	1	1	1	1	1	1	1	1
San Giovanni	41 14 N 15 46 E	1B	Surface: 2 runways - gravel, oiled ROP Taxiway - gravel	Runway Taxiway	2 ft depth 2 ft depth	Brown sandy clay Brown sandy clay	CL CL	0	1	1	1	1	1	1	1	1	1	1	1	1

TABLE 3. SUMMARY OF AIRFIELD TEST DATA (Cont.)

Group B: Italy

AIRFIELD

SAMPLE

SOIL TESTS

Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classification Symbol	Grain Sizes										Atterberg Limits			Mod. ASD Compaction				
								Max. Size > No. 10	Gravel	Sand	No. 10 to 40					No. 40 to 200					Liquid Limit		Plasticity Index	Max. Compaction	Dry Density
											100	60	40	20	10	5	2.5	1.25	0.6	0.3	0.15	0.075			
Torretta	41 11 N 15 46 E	EB	Surface: 2 runways - gravel, oiled MP Runway - gravel.	West runway East runway North runway South runway	2 ft depth 2 ft depth 2 ft depth 2 ft depth	Brown sandy clay Brown clay Brown sandy clay Brown sandy clay	CL ML CL CH	-	0	2	4	18	76	41	19	-	-	-	-	-	-	-	-	-	
Pontazola	41 06 N 15 25 E	EB	Surface: Runway - MP Runway - gravel.	Shoulder south Runway Runway	2 ft depth 2 ft depth 2 ft depth	Brown sandy clay Brown clay Brown sandy clay	CL ML CL	-	0	0	0	0	25	75	43	14	-	-	-	-	-	-	-	-	
Parl	41 09 N 16 47 E	EB	Surface: Runway - gravel, oiled Runway - tufa Runway - oiled	South runway North runway South runway	2 ft depth 2 ft depth 2 ft depth	Brown clay Brown clay Brown clay	CL ML CL	-	0	0	0	0	1	93	58	26	-	-	-	-	-	-	-	-	
Ponoma	41 00 N 15 50 E	EB	Surface: Runway - MP Runway - gravel.	West runway North runway	2 ft depth 2 ft depth	Brown clay (organic) Brown clay (organic)	CH CH	-	2	3	12	83	83	83	83	83	83	83	83	83	83	83	83	83	
Epimeresia	40 37 N 16 11 E	EB	Surface: Runway - MP on tufa Runway - tufa	South runway North runway	2 ft depth 2 ft depth	Brown sandy clay Dark brown clay	CH CL	-	0	0	0	0	24	76	57	23	-	-	-	-	-	-	-	-	
Gleola	40 47 N 16 36 E	EB	Surface: Runway - tufa Runway - oiled Runway - caliche	North runway South runway	2 ft depth 2 ft depth	Brown silt Brown silt (t) with crushed rock	ML(t) CL	-	0	0	1	11	88	88	88	88	88	88	88	88	88	88	88	88	
Brindisi	40 33 N 17 47 E	EB	Surface: Runway - conc. with asphalt topping and MP extension Runway - caliche Runway - MP, tufa and asphalt	South runway North runway Runway Runway	2 ft depth 2 ft depth 2 ft depth 2 ft depth	Brown sandy clay Red brown sandy clay Red brown sandy clay Red brown sandy clay	CL CH CH CH	-	0	0	0	0	43	57	26	11	-	-	-	-	-	-	-	-	
Grottaglie	40 31 N 17 28 E	EB	Surface: Runway - caliche Runway - oiled Runway - tufa	Runway West runway Runway	2 ft depth 2 ft depth 2 ft depth	Red brown clay Red brown clay with marine fossils	CH(t) CH CH	-	0	0	0	0	9	91	24	23	-	-	-	-	-	-	-	-	
Manduria	40 26 N 17 30 E	EB	Surface: Runway - oiled tufa Runway - oiled Runway - tufa	Runway Runway Runway	2 ft depth 2 ft depth 2 ft depth	Sandy clay Red brown sandy clay Red brown sandy clay	CL CL CL	-	1	9	23	61	61	61	61	61	61	61	61	61	61	61	61	61	
San Pancrazio	40 26 N 17 31 E	EB	Surface: Runway - soil cement & stone- asphalt Runway - soil cement & tufa	Runway Runway	2 ft depth 2 ft depth	Brown sandy clay Red brown sandy clay	CL CL	-	0	1	24	79	79	79	79	79	79	79	79	79	79	79	79	79	
Lecce	40 14 N 18 06 E	EB	Surface: Runway - asphalt with tufa exten- sion Runway - tufa	Runway Runway	2 ft depth 2 ft depth	Brown sandy clay Red brown sandy clay	CL CL	-	0	2	41	57	57	57	57	57	57	57	57	57	57	57	57	57	
Ciampino	41 44 N 12 35 E	EB	No information	Runway	2 ft depth	Runway	CL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Carcara	40 20 N 18 21 E	EB	Surface: Oiled	Runway	2 ft depth	Runway	CL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

TABLE 31. SUMMARY OF ADVANCED TEST DATA (Cont.)

O-imp 71- Africa

A I R P I E L D

S A M P L E

S O I L T E S T S

Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classi- fication Symbol	Grain Sizes										Atterberg Limits			Mod. AASRO Compaction Max.
								Max. Gravel Size >No. 10	% Gravel	% Sand 10 to 60		% Fines 60 to 200	% Fines	LL	PL	NP	Spec. Grav.	W.P.			
										Stems	Stems										
(1) BID IN CNO Cuba City	27 27 N 82 56 W	2	Description missing	Center of field	-	Two fine sand	GP	-	0	0	92	0	20	14	8	-	-	-	-		
(2) FRENCH KNOXCOG Newmarket	31 37 N 08 02 W	VB	Description missing	Original runway	Base course 1 ft depth	Red clayey sandy gravel	OC	1	48	12	40	20	20	14	8	-	-	-	-		
				Present runway	Base course 6 ft depth	Red silty sandy gravel	OM	1	67	12	9	12	12	11	6	-	-	-	-		
				Runway Area	Base course 4 ft depth	Red silty sandy gravel	OM	1	53	26	12	11	11	11	5	-	10	110	-		
				End of runway	Composite subgrade	Brown sandy clay	CL	-	2	10	24	64	30	13	2.71	-	-	-	-		
				Runway shoulders	Composite subgrade	Black sandy clay	CL	-	12	12	23	53	22	12	2.79	-	-	-	-		
Base El No	34 00 N 05 09 W	VB	Description missing	Runway pit Quarry	Fill	Gray crumbly rock	GP	3/8	78	19	3	66	24	9	2.63	-	-	-	-		
				-	-	Red silty sandy gravel	OM	3/4	51	9	13	27	-	-	-	-	-	-	-		
				-	-	Brown silty sandy gravel	OM	3/4	35	7	16	40	20	2	2.70	-	-	-	-		
				-	-	Brown clay	CL	-	0	3	14	83	49	25	2.69	-	-	-	-		
				Sample missing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
(3) ALBERTA (a) Base Area La Borda	35 36 N 00 57 W	VB	Surface: One paved runway	Sample missing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
			Surface: Asphalt seal coat runway	Centerline runway	1 ft depth	Red brown sandy clay	CL	-	0	5	29	70	30	9	-	-	-	-	-	-	
			Surface: Gravel north. Back 2-1/2 ft below gravel	Centerline runway	2 ft depth	Red brown sandy clay	CL	-	0	3	26	69	33	11	-	-	-	-	-	-	
			-	Centerline runway	2-1/2 ft depth	Red clay	GP	1-1/2	75	9	11	5	-	-	-	-	-	-	-	-	
			Description missing	Runway shoulder	1 ft depth	Gray clay	CL	-	0	1	13	86	43	20	2.70	-	-	-	-	-	
La Piedad	35 40 N 00 11 W	-	Incomplete	Runway shoulder	2 ft depth	Gray clay	CL	-	0	2	12	86	41	20	2.70	-	-	-	-	-	
			-	Runway shoulder	3 ft depth	Gray clay	CL	-	0	1	13	86	41	19	2.66	-	-	-	-	-	
			Surface: Emergency field, no runway	Sample missing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
			Surface: Emergency field, no runway	-	1 ft depth	Red clay	CL	-	0	0	10	90	33	14	2.69	-	-	-	-	-	
			Surface: Emergency field, no runway	-	2 ft depth	Red clay	CL	-	0	0	6	94	37	17	2.70	-	-	-	-	-	
La Piedad	36 40 N 00 06 E	VB	Surface: VET runway	-	-	Brown clay	CL	-	0	0	4	96	44	21	2.67	-	-	-	-	-	
			-	-	-	Brown clay	CL	-	0	0	6	94	44	20	2.68	-	-	-	-	-	
			-	-	-	Brown clay	CL	-	0	0	6	94	44	20	2.68	-	-	-	-	-	
			Surface: VET runway	Runway shoulder	-	Red brown sandy silt	ML	-	0	3	23	44	17	3	-	-	-	-	-	-	
			Surface: One hard surfaced runway	Runway shoulder	-	Red brown sandy clay	CL	-	0	3	23	44	17	3	-	-	-	-	-	-	
(4) ALBERTA (a) Base Area La Borda	36 40 N 01 13 W	VB	Surface: One hard surfaced runway	Runway shoulder	-	Red brown sandy clay	CL	-	0	3	23	44	17	3	-	-	-	-	-	-	
			Surface: One hard surfaced runway	Runway shoulder	-	Red brown sandy clay	CL	-	0	3	23	44	17	3	-	-	-	-	-	-	
			Surface: One hard surfaced runway	Runway shoulder	-	Red brown sandy clay	CL	-	0	3	23	44	17	3	-	-	-	-	-	-	
			Surface: One hard surfaced runway	Runway shoulder	-	Red brown sandy clay	CL	-	0	3	23	44	17	3	-	-	-	-	-	-	
			Surface: One hard surfaced runway	Runway shoulder	-	Red brown sandy clay	CL	-	0	3	23	44	17	3	-	-	-	-	-	-	
Wilson Mancho	36 42 N 01 13 W	VB	Surface: Asphalt runway	Sample missing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
			Surface: One hard surfaced runway	-	-	Brown clayey gravel	OC	1	68	6	4	22	26	9	-	-	-	-	-	-	
			Surface: One hard surfaced runway	-	-	Brown clayey gravel	OC	1-1/2	82	3	3	12	25	10	-	-	-	-	-	-	
			Surface: One hard surfaced runway	-	-	Red silty gravel	OM	-	-	-	-	-	22	5	-	-	-	-	-	-	
			Surface: One hard surfaced runway	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
La Borda	36 45 N 01 23 W	VB	Surface: Red & bar landing mat on runway	-	-	The silty sand	SM	-	2	7	27	34	21	3	-	12	118	16	Low	-	
			Surface: Clayey sandy soil, heavy after rain	-	-	The coarse to fine sand	SM	-	1	24	70	5	21	3	-	-	-	-	-	-	
			Surface: Clayey sandy soil, heavy after rain	-	-	The coarse to fine sand	SM	-	2	42	48	6	21	5	-	-	-	-	-	-	
			Surface: Clayey sandy soil, heavy after rain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
			Surface: Clayey sandy soil, heavy after rain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

SAMPLE										SOIL TESTS									
Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classification Symbol	Grain Sizes					Atterberg			Mod. AASD Compression Test.			
								No. Gravel Size > No. 10	% Coarse Sand 10 to 40	% Fine Sand 40 to 200	% Fines < No. 200	Sh. P.	Liquid Limit	Plasticity Index					
(a) Construction Notes								In.	Fl.	Fl.	Fl.	Fl.	Fl.	Fl.	Fl.	Fl.			
DJA4Jell	36 44 N 05 03 E	H	Surface: Part Subgrade: Heavy clay alluvium, heavy and soft after rains General: Subgrade south of site			Brown clay	CL	-	0	2	9	86	42	31	2.65	-			
								-	2	7	10	81	44	31	-	-			
								-	2	4	7	87	50	26	2.70	-			
Taber	36 49 N 05 45 E	H	Surface: Part Subgrade: Sandy clay, heavy after rains General: Clayey sandy soil			Black sandy clay	CL	-	0	3	20	77	39	17	2.63	-			
								-	0	5	26	69	31	14	2.63	-			
								-	0	5	25	70	33	17	2.63	-			
Taber	36 47 N 05 38 E	-	Surface: Part runway Subgrade: Clayey sandy soil General: Gravelly			Tan silty sand	SM(1)	-	4	45	84	27	-	-	-	-			
								-	2	5	7	86	48	22	2.67	-			
								-	0	0	7	93	45	20	2.72	-			
Phillipsville	36 51 N 06 57 E	F	Surface: Originally PSP, now sand & gravel Subgrade: Clay soil General: Sand & gravel, runway unusable all the time by light aircraft			Red silty sand	SM	-	0	15	69	16	16	2.63	-				
								-	6	10	54	32	16	2.63	-				
								-	-	-	-	-	-	-	-				
Bono	36 50 N 07 49 E	MB	Surface: Bituminous runways. Half of one runway & taxiway are PSP Base course: Macadam Subgrade: Clay soil, heavy after rains			Grey clay	CL	-	3	3	8	86	47	25	2.67	-			
								-	0	0	3	97	55	30	2.63	-			
								-	0	0	3	97	44	23	2.66	-			
Blaine	36 48 N 07 44 E	MB	Subgrade: Sandy soil General: Subgrade dusty when dry, soft & wet after rains. Muddy & rock supply			Tan sandy clay	CL	-	-	-	-	-	25	9	2.64	-			
								-	-	-	-	-	34	16	2.69	-			
								-	0	0	35	65	21	6	2.71	-			
Beverly	36 05 N 07 43 E	H	Subgrade: Light clay soil General: Subgrade heavy, soft & wet after rains. Muddy & unusable after heavy rains			Black clay	CL	-	0	3	6	91	47	22	2.69	-			
								-	0	5	6	85	45	16	2.66	-			
								-	7	13	34	66	40	12	2.65	-			
St. Dumet	36 06 N 06 00 E	H	General: Double all the time			Tan sandy gravelly silt	ML	3/4	31	3	24	42	25	3	2.59	-			
								-	36	5	14	45	31	7	2.60	-			
								-	93	4	3	0	11	11	2.62	-			
Chattanooga on Rhoad	36 10 N 06 08 E	H	Subgrade: Calcareous clay, rocky. Heavy after rains			Tan sandy gravelly clay	CL	1/2	37	5	13	45	32	10	2.64	-			
								-	10	8	15	67	11	11	2.68	-			
								-	54	23	17	6	11	11	2.67	-			
Timberlet	36 10 N 06 10 E	H	Description missing			Tan sandy clay	ML	-	0	0	30	70	35	9	2.65	-			
								-	1/2	38	4	11	11	2.66	-				
								-	-	7	6	9	78	33	10	2.67	-		
Tolargus	36 05 N 06 22 E	MB	Surface: Asphalt runway Base course: Crushed rock Subgrade: Turf soil, muddy after rains			Brown sandy gravel	GM	1	80	19	1	0	11	11	2.68	-			
								-	99	3	2	0	15	15	2.68	-			
								-	10	11	15	61	36	13	2.68	-			
Bartons No. 1	36 06 N (a 27 E	H	Subgrade: Calcareous clay, heavy after rains			Tan & brown clay	ML	-	1	4	13	82	50	13	2.57	-			
								-	1	3	11	85	53	23	2.62	-			
								-	0	0	7	54	50	23	2.64	-			
Bartons No. 2	36 06 N 06 20 E	H	Subgrade: Calcareous clay, heavy after rains			Tan sandy clay	CL	-	3	12	43	42	33	11	2.55	-			
								-	39	8	12	41	34	7	2.62	-			
								-	0	0	32	68	31	7	2.61	-			
Alta MTJala	36 01 N 06 35 E	H	Subgrade: Clayey soil, soft & heavy after rains General: Area flooded after heavy rainstorms of spring & autumn			Dark grey clay	CL	-	0	2	5	93	48	23	2.65	-			
								-	5	4	10	81	35	8	2.69	-			
								-	4	7	12	77	36	12	2.69	-			

TABLE 3: SUMMARY OF AIRFIELD TEST DATA (Cont.)

Gregg C. Africa

Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classi- fication Symbol	Grain Sizes										Mod. ASCE		
								Max. Gravel Size		% Gravel		% Sand		% Fines		Atterberg Limits		Spec. Grav.		Compaction
								in.	mm.	10 to 40	40 to 200	200 <	Plasticity	Shrinkage	Flow	LL	PL	U.S.	Opt.	
La Kroub	36 13 N 06 41 E	-	Subgrade: Clay-sand, soft after rains General: Double all the time. Half of runway is of stone. Incomplete	-	-	Black sandy clay	CL	-	-	0	7	20	73	41	15	2.63	-	-	-	-
Lamasara	-	M	Description missing	-	-	Black sandy clay	CL	-	-	0	7	19	74	39	15	2.65	-	-	-	-
Charguier	37 51 N 07 06 E	M	Surface: Bolled earth strip Subgrade: Light quick drying turf soil, soft after rains	-	-	Red clay	CL	-	-	0	3	7	40	43	17	2.63	-	-	-	-
Montecatini	36 05 N 07 32 E	M	Subgrade: Clay & turf soils General: Runway graded with scrapers. Double after rains with precautions	-	-	Red clay	CL	-	-	0	3	6	90	39	15	2.67	-	-	-	-
Yonke la Butte	37 30 N 07 56 E	P	Description missing	-	-	Red clay	CL	-	-	0	3	12	85	45	16	2.67	-	-	-	-
Tebenen	37 25 N 08 08 E	M	Subgrade: Clayey soil General: Double only in dry weather, danger- ous even after light rains. Underlying silt surface	-	-	Brown & grey sandy clay	CL	-	-	0	4	18	78	30	17	2.76	-	-	-	-
(a) Campagna Area	31 15 N 22 32 E	M	Subgrade: Clayey sand General: Firm after rains	-	-	Brown clay	CL	-	-	10	1	9	80	36	15	2.64	-	-	-	-
(a) Tangant Area	-	M	Description missing	-	-	Brown clay	CL	-	-	0	3	12	85	45	16	2.67	-	-	-	-
(b) TUBERIA	-	M	Surface: None General: Plowed field at present	-	-	Tan clay	CL	-	-	0	0	0	100	-	-	-	-	-	-	-
Utique	-	M	Surface: None General: Plowed field at present	-	-	Tan clay	CL	-	-	0	0	0	100	-	-	-	-	-	-	-
Proville No. 2	-	M	Surface: None General: Plowed field at present	-	-	Tan clay	CL	-	-	0	0	0	100	-	-	-	-	-	-	-
La Sebala No. 1	-	M	Surface: None General: Plowed field at present	-	-	Tan clay	CL	-	-	0	0	0	100	-	-	-	-	-	-	-
La Sebala No. 2	-	M	Surface: None General: Plowed field at present	-	-	Tan clay	CL	-	-	0	0	0	100	-	-	-	-	-	-	-
Djoudia No. 1	36 32 N 08 27 E	M	Surface: Asphalt paving	-	-	Tan clay	CL	-	-	0	0	0	100	-	-	-	-	-	-	-
Djoudia No. 2	36 49 N 09 37 E	M	Surface: Asphalt paving	-	-	Tan clay	CL	-	-	0	0	0	100	-	-	-	-	-	-	-
Fouat el Doudia No. 1	36 32 N 08 56 E	M	Surface: None General: Plowed field at present	-	-	White sandy gravel	GM	1-1/2	83	11	6	5	95	0	0	NP	-	-	-	-
Souk el Doudia No. 3	36 30 N 08 55 E	M	Surface: None General: Plowed field at present	-	-	Brown clay	CL	-	-	0	0	0	100	-	-	-	-	-	-	-
						Brown clay	CL	-	-	0	0	0	100	-	-	-	-	-	-	-
						Brown clay	CL	-	-	0	0	0	100	-	-	-	-	-	-	-
						Brown sandy clay	CL	-	-	0	0	0	100	-	-	-	-	-	-	-
						Brown sandy clay	CL	-	-	0	0	0	100	-	-	-	-	-	-	-

TABLE 11. SUMMARY OF AIRFIELD TEST DATA (Cont.)

Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classi- fication Symbol	SOIL TESTS									
								Grain Sizes									
								Max. Gravel Size > No. 10 Sieve, in.	% Gravel > No. 10 Sieve	% Sand > No. 40 to 200 Sieve	Atterberg Limits, %	Spec. Grav., %	Opt. Grav., %	Mod. ASHED Compaction, %			
											LL	PL			Y _d		
El Bathan	36 48 N 09 51 E	M	Surface: None General: Plowed field at present	-	-	Brown clay	CL	-	0	0	5	99	34	15	-	-	-
Muscault	36 43 N 09 59 E	ED	Surface: None General: Plowed field at present	-	-	Brown clay	CL	-	0	3	13	84	46	26	-	19	102 8 Low
Oudra	36 38 N 10 06 E	-	Surface: Asphalt paving	-	-	Brown clay	CL	-	0	3	3	94	46	24	-	-	-
Deplenne	36 25 N 10 02 E	ED	Surface: Asphalt paving	-	-	Brown clay	CL	-	0	1	7	92	30	12	-	16	112 10 Low
Pont du Pabu	36 20 N 09 50 E	M	Surface: None General: Plowed field at present	-	-	Brown sandy clay	CL	-	0	2	19	79	33	16	-	13	117 10 Low
Le Sere	36 02 N 09 15 E	M	Surface: None General: Plowed field at present	-	-	Gray clay (Organic) Gray clay Gray clay	CH CH CH	- - -	0 0 0	1 1 7	7 92 92	55 32 30	31 29 30	- - -	- - -	-	-
Le Kouif	-	M	Description missing	-	-	Brown clay Tan gravelly sandy clay White gravelly sand	ML ML SH	- 1/2 3/8	0 15 43	0 13 36	8 12 15	92 60 6	34 35 8	9 8 2.64	- - -	-	-
Arian	-	M	Description missing	-	-	Brown clay	CL	-	0	0	14	86	27	10	-	12	121 7 Low
La Merve	-	M	Surface: None General: Plowed field at present	-	-	Gray sandy clay Tan silty sand Tan silty sand	CL SH SH	- - -	0 0 11	0 71 78	1 28 11	99 71 11	22 28 11	- - -	- - -	-	-
Toula (possibly El Aouina)	-	-	Description missing	-	-	Silty sand	SM(1)	-	0	0	72	28	-	-	-	-	-
Fech	-	M	Surface: None General: Plowed field at present	-	-	Brown clay	CL	-	0	0	9	91	40	23	-	15	114 13 Low
Solima No. 1	-	M	Description missing	-	-	Clay Brown gravelly sand	CE SH	- -	0 45	0 19	3 30	97 6	56 30	30 -	- -	19	109 7 Low
Solima No. 2	-	M	Surface: None General: Plowed field at present	-	-	Brown clay Gray clay	CL CL	- -	0 0	0 0	6 100	94 53	43 35	21 -	- -	-	-
Solima No. 3	-	M	Surface: None General: Plowed field at present	-	-	Brown clay Brown sandy clay (Organic)	CL CL	- -	0 1	4 5	14 17	82 77	42 39	24 20	- -	14	116 7 Low
Goudalis	-	M	Surface: None General: Plowed field at present	-	-	Brown clay with small shells	CL	-	0	0	11	89	46	25	-	13	114 6 Low
El Mouarria	-	N	Surface: None	-	-	Gray sandy clay, cemented with small shells	CL	-	0	0	54	46	32	16	-	-	-
Moussal-Toussine	-	M	Surface: None General: Plowed field at present	-	-	Brown sandy gravel (white rock)	CP	1	54	10	30	6	-	-	-	13	116 50 Low
Elr Mousside	-	M	Surface: None General: Plowed field at present	-	-	Red-brown sandy clay (Organic)	CL	-	0	5	53	42	25	10	-	12	118 7 Low
Korta	-	M	Surface: None	-	-	Red sandy clay	CL	-	0	8	48	44	24	10	-	-	-
Bousser	-	M	Surface: None General: Plowed field at present	-	-	Brown clay	CH	-	0	1	3	96	75	48	-	23	100 5 High
(1) DATA (Tripetil) (2) DATA (Tripetil) (3) DATA (Tripetil)	36 24 N 10 02 E	-	Surface: Asphalt runway, taxiway & apron	-	Subgrade Subgrade Base course	Tan sandy silt Tan silty sand Gray crushed rock	ML SM GW	- - 1-1/2	2 0 100	2 2 0	51 59 0	45 39 0	- - -	- - -	-	10 14 -	117 25 Low 106 20 Low -

TABLE 3. SUMMARY OF AIRFIELD TEST DATA (Cont.)

Sheet 10 of 24

Group C1 Africa

AIRFIELD

SAMPLE

SOIL TESTS

Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classification Symbol	Grain Size											Moist. ASDM Comparative Mar.
								Test Gravel Size	Test Sand Size	Test Silt Size	Test Clay Size	Plasticity				Atterberg Limits			
												LL	PL	PI	Shr. Grav.	Opt. Grav.	Opt. Y. S.	Opt. C. P.	
SAMPLE																			
(6) FRANCE WEST AFRICA: Mallard (Inshore)	14 44 N	80,000	Description missing	Apron	-	Gray rock	GP	1-1/2	100	0	0	0	0	0	0	0	0	0	-
	17 30 E	1b	grass		-	Gray silty sand	SM	-	0	30	27	13	13	0	0	0	0	0	-
(7) GOLD COAST: Nambour	04 24 N	20	Description missing	East edge of runway at mid-point	-	Gray rock with asphalt	GP	1-1/2	100	0	0	0	0	0	0	0	0	0	-
	01 40 E	1b	grass		-	Red sandy clay	CL	1 1/2	14	1	35	50	32	13	2.77	2.77	2.77	2.77	-
Acra	05 15 N	VB	Description missing	North edge at approx. center of runway	-	Red clayey sandy gravel	OC	1	40	3	20	37	31	13	2.91	2.91	2.91	2.91	-
	00 10 E	1b	grass		-	Brown sandy clay	CL	-	0	3	45	50	24	5	2.74	2.74	2.74	2.74	-
(8) FRANCE WEST AFRICA: Polinae Ridge	04 49 S	75,000	Description missing	North edge at approx. center of runway	-	Red sandy clay	CL	-	0	8	38	34	26	9	2.68	2.68	2.68	2.68	-
	11 51 E	1b	grass		-	Red sandy silt	ML	-	5	9	38	40	23	2	2.62	2.62	2.62	2.62	-
(9) BELGIAN CONGO: Leopoldville	04 20 S	100,000	Description missing	North edge at approx. center of runway	-	Red sandy silt	ML	-	0	9	39	36	26	5	2.62	2.62	2.62	2.62	-
	15 10 E	1b	grass		-	Gray silty sand (Organic)	SM	-	0	9	74	17	17	17	2.50	2.50	2.50	2.50	-
Elizabethville	11 39 S	72,000	Description missing	-	-	Gray silty sand (Organic)	SM	-	0	9	74	17	17	17	2.59	2.59	2.59	2.59	-
	27 20 E	1b	grass		-	Black silty sand	SM	-	0	10	78	12	12	12	2.60	2.60	2.60	2.60	-
(10) NIGERIA: Agape	04 20 S	100,000	Description missing	North edge at approx. center of runway	-	Dark gray silty sand	SM	-	0	10	78	12	12	12	2.60	2.60	2.60	2.60	-
	15 10 E	1b	grass		-	Light gray silty sand	SM	-	0	6	75	19	19	19	2.63	2.63	2.63	2.63	-
Maiduguri	11 39 S	72,000	Description missing	-	-	The sandy gravelly clay	CL	-	18	7	8	67	36	15	-	-	-	-	-
	27 20 E	1b	grass		-	The sandy gravelly clay	CL	-	-	-	-	-	-	-	-	-	-	-	-
(11) ANGOLA-WEST: El Comienzo	06 26 N	26,000	Description missing	East edge at approx. center of runway	-	The sandy gravelly clay	CL	-	-	-	-	-	-	-	-	-	-	-	-
	03 23 E	1b	grass		-	The coarse to fine sand	SM	-	0	48	52	0	0	0	2.63	2.63	2.63	2.63	-
Bano	11 29 N	VB	Description missing	North edge at approx. center of runway	-	The coarse to fine sand	SM	-	0	56	39	3	3	3	2.62	2.62	2.62	2.62	-
	13 08 E	1b	grass		-	The coarse to fine sand	SM	-	0	50	50	0	0	0	2.62	2.62	2.62	2.62	-
El Pabon	11 29 N	VB	Description missing	North edge at approx. center of runway	-	The coarse to fine sand	SM	-	0	50	50	0	0	0	2.62	2.62	2.62	2.62	-
	13 08 E	1b	grass		-	The silty sand	SM	-	0	9	69	26	26	26	2.63	2.63	2.63	2.63	-
Mall de San	12 03 N	VB	Description missing	North edge at approx. center of runway	-	The silty sand	SM	-	0	10	61	29	29	29	2.66	2.66	2.66	2.66	-
	00 32 E	1b	grass		-	Reddish silty sand	SM	-	0	10	56	34	34	34	2.66	2.66	2.66	2.66	-
(12) ANGOLA-WEST: El Comienzo	13 27 N	VB	Description missing	-	-	Red silty sand	SM	-	0	4	69	27	27	27	2.62	2.62	2.62	2.62	-
	22 26 E	1b	grass		-	Red silty sand	SM	-	0	2	66	32	32	32	2.61	2.61	2.61	2.61	-
El Pabon	13 38 N	VB	Description missing	-	-	Red silty sand	SM	-	0	2	62	36	36	36	2.62	2.62	2.62	2.62	-
	29 20 E	1b	grass		-	The coarse to fine sand	SM	-	0	41	54	5	5	5	-	-	8	127	75
Mall de San	15 47 N	VB	Description missing	-	-	Brown silty sand	SM	-	0	9	69	22	22	22	-	-	9	125	44
	32 32 E	1b	grass		-	Brown sandy silt	ML	-	0	14	41	45	45	25	6	-	10	127	6
(13) ANGOLA-WEST: Aman	15 18 N	130,000	Description missing	-	-	Brown sandy clay	ML	-	0	9	16	79	79	15	14	-	21	124	12
	30 50 E	1b	grass		-	Brown sandy clay	ML	-	0	9	16	79	79	15	14	-	21	124	12

TABLE 3. SUMMARY OF AIRFIELD TEST DATA (Cont.)

Sheet 11 of 26

Group C: Africa

AIRFIELD										SAMPLE										SOIL TESTS									
Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classi- fication Symbol	Grain Sizes					Atterberg Limits					Mod. AACRO Compaction Max.											
								Var. Gravel Size	Coarse Sand	Fine Sand	Fines	LL	PL	Sh. d.s.	CF	Well													
								No. 10 to 40 Sieve	40 to 200 Sieve	<No. 200 Sieve	LL	PL	Sh. d.s.	CF	Well														
Gura	15 01 N 39 06 E	ED	Description missing			Thin sandy clay	CL	0	34	22	44	27	0	2	1	Low													
(13) MITY: Pagan Field (Colony)	30 00 N 31 26 E	VED	Description missing	Sample missing																									

Best Available Copy

TABLE 3: SUMMARY OF AIRFIELD TEST DATA (Cont.)

Group D: Near East, India, Burma, China

AIRFIELD										SAMPLES										SOIL TESTS									
Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classification Symbol	Max. Gravel Size In.	Grain Sizes					Atterberg Limits			Moist. Analysis												
									Sieve	Sieve	Sieve	Sieve	Sieve	PI	FL	Grav. Wt. %	Y. o. CBR	Swell											
(1) CHINA MAP:																													
(a) Tientsin																													
Wang Tung	39 57 N 116 41 E	EB	No information	Runway	Subgrade	Brown clay	CL	-	0	0	0	6	94	66	42	-	19	106	5	Low									
Wang Tung				Taxiway	Subgrade	Brown clay	ML	-	0	0	0	0	100	63	34	-	22	96	5	High									
Wang Tung				Apron	Subgrade	Brown clay	CH	-	0	0	0	4	96	106	92	-	23	100	2	High									
(b) Tientsin																													
Civil Airport	39 57 N 116 46 E	7	No information	East taxiway	Subgrade	Brown clay	CL	-	0	0	0	3	97	59	34	-	10	110	5	Low									
Civil Airport				Runway	Subgrade	Gray sandy clay	CL(1)	-	2	15	23	75	0	-	-	-	-	-	-	-									
Civil Airport				West taxiway	Base course	Gray sandy gravel	GM	1	72	27	1	0	0	NP	-	7	128	60	Low										
(c) Tientsin																													
Byrie (Latham)	33 58 N 115 29 E	7	No information	-	-	Brown fine sand	SP	-	0	10	90	0	0	NP	-	-	-	-	-	-									
(d) Tientsin																													
Pakistan	32 00 N 74 36 E	EB	No information	-	Subgrade	Brown clay	CL	-	0	2	6	92	42	20	-	-	-	-	-	-									
Pakistan				-	-	Brown sandy clay	CL(1)	-	4	36	17	43	-	-	-	-	-	-	-	-									
(e) Tientsin																													
India	32 23 N 75 35 E	EB	No information	Runway inter-section	-	Fin. sandy gravelly clay	CL	3/4	34	5	16	45	28	7	-	-	-	-	-	-									
India				South and long	-	Brown silty gravelly sand	SM	1/4	20	18	49	13	NP	-	-	-	-	-	-	-									
India				South and short	-	Black silty sandy gravel	GM	3/4	45	9	22	21	22	1	-	-	-	-	-	-									
India				Runway	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-									
(f) India																													
India	30 22 N 75 15 E	VB	No information	South end short runway	-	Black sandy clay	CL	-	-	-	-	-	34	11	-	13	111	10	Low										
(g) India																													
India	26 16 N 75 38 E	7	No information	Runway	Soil type: of entire island	White silty sand	UM	-	0	15	64	21	NP	-	-	-	-	-	-	-									
(h) India																													
India	12 50 N 74 58 E	VB	No information	-	-	Brown silty sand	SM	-	-	-	-	-	-	NP	-	-	-	-	-	-									
(i) India																													
India	17 03 N 74 08 E	EB	No information	-	-	Fin. sandy silt	ML	-	10	20	23	47	22	5	-	9	128	7	Low										
(j) India																													
India	20 40 N 74 54 E	EB	No information	-	-	Brown sandy silt	ML	-	1	14	38	47	17	3	-	8	134	12	Low										
(k) India																													
India	27 08 N 77 38 E	EB	No information	Short runway southeast and center	-	Brown sandy silt	ML	-	0	0	0	20	50	NP	2.66	9	120	12	Low										
India				Long runway southeast end	-	Fin. sandy silt	ML	-	0	0	0	45	25	NP	2.68	10	122	7	Low										
India				-	-	Brown sandy silt	ML	-	0	0	0	40	60	19	1	2.66	-	-	-	-									
(l) India																													
India	24 34 N 67 09 E	EB	No information	Borrow area	-	Fin. coarse to fine sand	SM	3/4	14	51	35	0	NP	2.68	-	-	-	-	-	-									
India				Borrow area	-	Fin. coarse to fine sand	SM	1	72	24	3	0	NP	2.63	-	-	-	-	-	-									
India				West of runway	Subgrade	Fin. sandy gravel	SM	1/10	35	24	16	23	17	2	2.68	5	138	35	Low										
India				South approach to runway	-	Fin. sandy sand	SM	-	13	28	29	30	-	-	2.68	8	134	-	-	-									
India				Disposal area	-	Fin. sandy silt	ML	-	2	10	46	42	NP	-	-	-	-	-	-	-									

TABLE 11. SUMMARY OF ADDED TEST DATA (Cont.)

Group D: Near East, India, Burma, China

Name and Location (1) Sample Data	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classi- fication Symbol	Grain Sizes										Mod. ASBO Compaction M.S.	
								Max. Gravel File It.	Gravel >No. 10 It.	Sand No. 10 to 40 Gravel It.	Sand >No. 40 to 200 Gravel It.	Flint <No. 200 Gravel It.	Other Gravel It.	Other Gravel It.	Other Gravel It.	Other Gravel It.	Other Gravel It.	Other Gravel It.	Other Gravel It.
								1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2
Cebu	24 45 N 124 57 E	B	2 runways: 4" conc. on original tarmac surface	Turnaround	Upper base course	White & black rock	GP	1-1/2	96	3	1	0	HP	-	-	-	-	-	-
			Turnaround: North-South runway: surface: 6 in. concrete Base: 2" layer of sand & crushed rock over 6"-8" layer of large stone General: Low ground with water table near surface. Concrete broke up under medium traffic	Turnaround	Subgrade	Gray clay	CL	-	1	6	-	66	13	10	125	10	Low	-	-
Cebu	11 32 N 124 57 E	B	2 runways: 5" conc. on 3" tarmac on 6" stone test pit Surface: 6"-8" conc. on 3" tarmac on two courses of brick General: Medium traffic. Cond. excellent	Runway	Thermal layer	Crushed gray & red laterite	GM	1-1/2	98	7	5	0	HP	-	-	-	-	-	-
			Surface: 7" conc. over original runway surface, 9" conc. on runway extension Base: Runway extension: 5" (stone) General: Medium traffic. Cond. excellent	Runway	Subgrade	Gray clay	GM	-	0	0	11	63	13	17	112	5	Low	-	-
Florida	26 42 N 81 20 E	VB	Surface: 7" conc. over original runway surface, 9" conc. on runway extension Base: Runway extension: 5" (stone) General: Medium traffic. Cond. excellent	Runway	Subgrade	Gray clay	GM	-	0	0	11	63	13	17	112	5	Low	-	-
			Surface: 7" conc. over original runway surface, 9" conc. on runway extension Base: Runway extension: 5" (stone) General: Medium traffic. Cond. excellent	Runway	Subgrade	Gray clay	GM	-	0	0	11	63	13	17	112	5	Low	-	-
Thailand	22 22 N 99 42 E	VB	Surface: 7" conc. over original runway surface, 9" conc. on runway extension Base: Runway extension: 5" (stone) General: Medium traffic. Cond. excellent	Runway	Subgrade	Gray clay	GM	-	0	0	11	63	13	17	112	5	Low	-	-
			Surface: 7" conc. over original runway surface, 9" conc. on runway extension Base: Runway extension: 5" (stone) General: Medium traffic. Cond. excellent	Runway	Subgrade	Gray clay	GM	-	0	0	11	63	13	17	112	5	Low	-	-
Davao	22 16 N 124 12 E	VB	Surface: 5" conc. over original runway surface, 10" conc. on runway extension Base: 6" laterite (extension) General: Medium traffic. Cond. excellent	Runway	Subgrade	Gray clay	GM	-	0	0	11	63	13	17	112	5	Low	-	-
			Surface: 5" conc. over original runway surface, 10" conc. on runway extension Base: 6" laterite (extension) General: Medium traffic. Cond. excellent	Runway	Subgrade	Gray clay	GM	-	0	0	11	63	13	17	112	5	Low	-	-
Burma	22 46 N 95 22 E	B	Surface: 2 layers 750 No. 6 on 3 courses of brick Base: 10" base course General: Medium traffic. Cond. excellent	Runway	Subgrade	Gray clay	GM	-	0	0	11	63	13	17	112	5	Low	-	-
			Surface: 2 layers 750 No. 6 on 3 courses of brick Base: 10" base course General: Medium traffic. Cond. excellent	Runway	Subgrade	Gray clay	GM	-	0	0	11	63	13	17	112	5	Low	-	-
Davao	22 37 N 124 27 E	B	Surface: 5" conc. over original runway surface, 10" conc. on runway extension Base: 6" laterite (extension) General: Medium traffic. Cond. excellent	Runway	Subgrade	Gray clay	GM	-	0	0	11	63	13	17	112	5	Low	-	-
			Surface: 5" conc. over original runway surface, 10" conc. on runway extension Base: 6" laterite (extension) General: Medium traffic. Cond. excellent	Runway	Subgrade	Gray clay	GM	-	0	0	11	63	13	17	112	5	Low	-	-
Tegay	23 41 N 90 23 E	B	Surface: 3 courses of cement-grouted brick General: Medium traffic. Cond. excellent	Runway	Subgrade	Gray clay	GM	-	0	0	11	63	13	17	112	5	Low	-	-
			Surface: 3 courses of cement-grouted brick General: Medium traffic. Cond. excellent	Runway	Subgrade	Gray clay	GM	-	0	0	11	63	13	17	112	5	Low	-	-
Thailand	24 24 N 91 52 E	B	Surface: 6 in. concrete Base: Compacted subgrade General: Two lanes, no ground water problem Medium traffic. Condition excellent	Runway	Subgrade	Red sandy clay	ML	-	0	2	31	67	39	11	2.64	-	-	-	-
			Surface: 6 in. concrete Base: Compacted subgrade General: Two lanes, no ground water problem Medium traffic. Condition excellent	Runway	Subgrade	Red sandy clay	ML	-	0	2	31	67	39	11	2.64	-	-	-	-
Thailand	25 51 N 101 26 E	B	Surface: 5"-7" concrete Base: 6"-8" stone base course General: River valley; water table 3-6' below ground. Medium traffic. Condition excellent	Runway	Subgrade	Gray silt	ML	-	0	0	6	94	87	-	-	-	-	-	-
			Surface: 5"-7" concrete Base: 6"-8" stone base course General: River valley; water table 3-6' below ground. Medium traffic. Condition excellent	Runway	Subgrade	Gray silt	ML	-	0	0	6	94	87	-	-	-	-	-	-

TABLE 3: SUMMARY OF AIRFIELD TEST DATA (Cont.)

Group 2: Near East, India, Burma, China

AIRFIELD			SAMPLE			SOIL TESTS											
Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classification Symbol	Grain Sizes					Atterberg Limits		Mod. ASD		
								Max. Size	Gravel	Sand	Fines	U	PL	Grav. %	Opt. No.		
(1) Asian Test F	26 43 N 92 45 E	EB	Surface: Sand-asphalt on 4" concrete base. Base: 4" base course. General: River valley; water table near ground surface. Original concrete surface broke up, necessitating sand-asphalt topping.	Samples missing	-	-	-	-	-	-	-	-	-	-	-	-	
Chabua	27 25 N 92 04 E	EB	Surface: 6 in. tar-mac. Base: 6 in. stone on sand cushion. General: Two lands; water table close to surface. Very heavy traffic. Condition excellent.	Runway	Subgrade	Gravel and asphalt. Tan sandy silt.	MC	-	0	1	31	68	-	-	-	-	
(2) Asian Test F	12 57 N 77 35 E	EB	Surface: Sand-asphalt on cement-grouted stone. General: Undulating ground; no water problem. Medium traffic. Condition excellent.	Samples missing	-	-	-	-	-	-	-	-	-	-	-	-	
(3) Asian Test F Salangpung	26 41 N 96 12 E	EB	Surface: Asphalt surface treatment. Base: Stabilized gravel. General: Jungle area; no ground water problem. Medium traffic. Cond. good.	Runway	Surface	Gravel and asphalt. Gray sandy gravel. Brown sandy clay.	GM	2	75	2	13	63	-	-	-	-	
Witkyim South	25 23 N 97 21 E	EB	Surface: 1" asphalt surface treatment. Base: Mechanically stabilized clay-gravel.	Runway	Subgrade	Gravel and asphalt. Brown silty sandy gravel.	GM	1-1/2	58	1	6	35	-	-	-	-	
Promo	28 16 N 97 15 E	EB	Surface: 1" asphalt surface treatment. Base: Mechanically stabilized clay-gravel.	Runway	Subgrade	Gravel and asphalt. Brown silty gravel. Brown sandy clay.	GM	1/2	20	18	23	39	-	-	-	-	
Ischia	22 59 N 97 15 E	EB	Surface: 3/8" asphalt surface treatment. Base: Crushed rock.	Runway	Subgrade	Gravel and asphalt. Crushed rock. Red clayey sand.	GM	1	87	7	4	2	-	-	-	-	
(4) Asian Test F Asian (Siam)	28 16 N 105 45 E	EB	Base: Portland, 7" to 8" thick. General: Heavy traffic. (MB, T & F)	-	-	Gray sandy clay	CL	-	1	16	38	45	-	-	-	-	
Wachusa	33 16 N 107 16 E	EB	Base: Water-bound gravel, 8" thick. General: Light traffic. (MB, T & F)	-	-	Brown sandy clay	CL	-	0	8	37	55	-	-	-	-	
Mauchang	33 06 N 107 03 E	EB	Base: Portland, 16" thick. General: Moderate to heavy traffic. (MB & T)	-	-	Brown sandy silt	MC	-	0	3	31	66	-	-	-	-	
(5) Asian Test F Pangphangdon	30 42 N 108 05 E	EB	Base: Water-bound gravel, 8" thick. General: Severe drainage problem. Moderate traffic. (T & F)	-	-	Brown & gray gravelly clay	CL	1/10	20	2	6	72	-	-	-	-	
Shuang-Lin	30 33 N 103 54 E	EB	Base: Water-bound gravel, 8" thick. General: Soft in wet weather. Light traffic.	-	-	Gray clay	CL	-	0	1	9	87	-	-	-	-	
Ma-Ching	30 25 N 103 49 E	EB	Surface: Single asphalt treatment. Base: Water-bound gravel, 20" thick. General: Very heavy traffic. (VMB)	-	-	Gray clay	MC	-	0	0	2	97	-	-	-	-	

TABLE 3: SUMMARY OF AIRFIELD TEST DATA (Cont.)

Sheet 15 of 24

Group 2: Near Isat, India, Burma, China

AIRFIELD

SAMPLE

SOIL TESTS

Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classi- fication Symbol	Grain Sizes					Atterberg Limits		Moist. Limit Opt. Moist.
								No. of Gravel Site	Gravel >20.0 in.	% Coarse Sand 40 to 200 Sieve			Liquid Limit LL	Plasticity Index PI	
										Sieve	Sieve	Sieve			
Pai-Sai-I	23 32 N 106 22 E	50,000 lb gross	Base: Water-bound gravel, 12" thick General: Heavy traffic. (NB, T & F)	Sample missing	-	-	-	-	-	-	-	-	-	-	-
La-Bates	25 51 N 105 21 E	64,000 lb gross	Surface: 6" cement-bound macadam Base: Water-bound gravel, 10" thick General: Heavy traffic. (F)	-	-	Brown sandy silt	MC	-	0	3	42	97	25	4	2.7%
(c) Burma Province															
Maung-Pa	27 52 N 113 34 E	100 lb	Base: Telford, 12" thick General: Light traffic	-	Subgrade	Red sandy clay	CH	-	0	12	17	71	51	25	4.7%
Chap-Chiang	27 26 N 109 36 E	35,000 lb gross	Base: Telford, 12" thick	-	Subgrade	Brown clay	CL	-	-	-	-	-	32	11	2.62
(d) Kwitchoo Province															
Chia-Chin	26 27 N 107 42 E	35,000 lb gross	Base: Water-bound gravel, 12" thick General: Moderate traffic. (NB & F)	-	Subgrade	Tan sandy clay	CL	-	0	6	20	74	30	11	2.60
Ching-Chen	26 35 N 106 25 E	35,000 lb gross	Base: Telford, 12" thick General: Moderate traffic. (F & Lt. F)	-	Subgrade	Tan clay	CH	-	0	0	8	92	54	31	2.71
Tu-Shen	25 46 N 107 31 E	35,000 lb gross	Base: Telford, 12" thick General: Light traffic. (Light F)	-	Subgrade	Gray sandy silt	ML	3/8	11	9	11	69	23	6	2.66
(e) Yunnan Province															
Chao-I	25 37 N 103 50 E	64,000 lb gross	Base: Telford, 20" thick General: Heavy traffic	-	Subgrade	Red clay	CL	-	0	4	12	84	39	17	2.70
La-Liang	25 00 N 103 30 E	110,000 lb gross	Base: Telford, 18" and 10" thick General: Heavy traffic. (VB)	-	Subgrade	Brown clayey sand	SC	-	0	26	50	24	42	8	-
(f) Yunnan Province															
Li-Chuan	26 18 N 109 14 E	VB	Base: Telford, 20" thick General: Twice destroyed and rebuilt. Heavy traffic of all types	-	Subgrade	Tan sandy clay	CL	-	0	16	30	52	32	18	2.68
Maung	22 49 N 100 37 E	14, 7 lb	Base: Telford and brick, 18" and 10" thick General: Destroyed and rebuilt twice. Moderate traffic	-	Subgrade	Tan sandy clay	ME	-	0	14	12	74	52	21	2.69

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TABLE 1. SUMMARY OF AIRFIELD TEST DATA (Cont.)

Sheet 15 of 24

Group E, Pacific Islands

Base and Location	Latitude and Longitude	Field Class.	Airfield Description	Locality	Material	Description	Classification Symbol	SOIL TESTS										Moist. ACHD Deposition Rate	
								Grain Sizes											
								Fls. > No. 10	Gravel	Sand	Silt	Clay	Plasticity	Atterberg Limit	Flow	Spec. Grav.			
(1) PHILIPPINES (a) Zamboanga	16 11 N 120 32 E	F, 10	Surface: Bank-run gravel with penetration asphalt. Base: Sand & gravel, thin. (2" base plus surface) Subgrade: Up to 6" fine organic sand overlying coarse uniform beach sand General: Terrains: Flat coastal plain, grassland surrounded by rice paddies. Drainage problems during rainy season. Maximum monthly rainfall: 76" in August. Water table: 4-15" depth. Condition 1 use: Surface unsatisfactory under heavy planes, necessitating patching	-	Base coarse: 1" thick Principal upper subgrade: 0-3" thick Intermediate subgrade: 0-6" thick Lower & intermediate sub-grade: 1/2" - 3-1/2" thick	Brown coarse to fine sand	DN	-	13	47	40	-	-	N I	0.6	-	-	-	
						Dark brown silty sand	SM	-	0	16	24	-	-	N I	0.04	1	129	-	
						Tan silty sand	SM	-	-	-	-	-	-	N I	0.7	14	13	40	
						Gray silty gravelly sand	SM	1	24	17	35	23	-	N I	0.7	-	-	-	
Manila	16 03 N 120 33 E	D	Surface: Road all treatment Base: Base Subgrade: Put yellow to brown clay General: Terrains: Low flat plain, grassland Maximum monthly rainfall: 23" in August. Water table: 4-6" depth. Condition 1 use: Abandoned invasion field now overgrown with grass	-	Surface: 3" thick Typical soil	Oiled soil Brown sandy clay	CL	-	0	10	26	62	62	N I	0.71	1	114	10	
Iloilo	16 08 N 120 20 E	D	Surface: Steel mat over asphalt treatment Base: 6" mix of river gravel & subgrade soil Subgrade: Uniform beach sand General: Terrains: Beach area; strip parallel to Gulf grassland Maximum monthly rainfall: Same as Manila. Water table: 4-6" depth. Condition 1 use: Good, but surface very	-	Base coarse: 6" thick Upper sub-grade: 0-2" thick Lower sub-grade & fill	Brown gravelly sand	GP	1-1/2	45	13	38	4	4	N P	0.06	-	-	-	
						Brown fine sand	SP	-	0	1	99	4	4	N P	2.73	11	107	21	
						Gray & tan fine sand	SP	-	0	1	97	2	2	N P	2.76	-	-	-	
Clark	15 11 N 120 33 E	F, 10	Surface: Wet runway; asphalt. Base runway: Put over asphalt. Aggregate: crushed river gravel < 3/4" Base: Thin layer of asbestos perlite gravel Subgrade: Poorly graded organic sand with some fine sand & gravel water in upper zone. Terrains: Flat to gently rolling; grassland with a few rice paddies. Surface made easily erodible. Water table: At great depth. Condition 1 use: Runways in good condition. Under very heavy traffic of all types	-	Typical base coarse Typical fill: 1/2" - 3-1/2" thick Upper sub-grade: 0-3" thick Lower subgrade Typical upper soil	Gray silty sandy gravel Gray clayey sand with pebbles Gray sandy silt (organic) Gray silty sand Black sandy silt	GM	1-1/2	35	13	25	24	24	N P	-	-	-	-	
						Gray clayey sand with pebbles	SC	-	-	-	-	-	-	-	-	2.64	-	-	
						Gray sandy silt	ML	-	1	7	48	44	44	N P	2.61	17	16	16	
						Gray silty sand (organic)	SM	3/8	10	29	44	14	14	N P	2.79	11	117	45	
						Black sandy silt	ML	-	2	13	42	43	43	N P	2.62	14	107	29	
San Marcelino	14 35 N 120 22 E	D	Surface: Same Base: Well-compacted 1" decomposed asbestos coarse (in effect clay-gravel course) Subgrade: Upper - fine gray organic sand (stratified in center of runway); lower - essentially a coarse organic sand	-	Selected fill & surfacing: 1-6" thick Upper subgrade: 3-1" thick Lower subgrade	Tan sandy silt Brown silty sand Gray gravelly sand	ML(1) SM SM	-	6	22	29	43	43	-	-	2.67	12	121	
																	2.69	6	
																	2.66	11	
																	2.66	11	
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Group I: Pacific Islands

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TABLE 3: SUMMARY OF AIRFIELD TEST DATA (Cont.)

Group B: Pacific Islands

A I R F I E L D			S A M P L E			S O I L T E S T S														
Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classification Symbol	Grain Sizes										Mod. ALSO		
								Mar. Gravel	Coarse Sand	Fine Sand	Slime	Atterberg Limit	Spec. Grav.	Opt. Hum.	Y ₁	Y ₂	Y ₃	Y ₄	Y ₅	
(c) Palamas Punta Prieta	09 44 N 118 45 E	B	Surface: Steel mat on top cover, runway & on base course of runway extension. Base: Mixture of crushed coral, clay, & beach gravel. Thickness: 6" over coral bedrock, 12" over residual clay. Subgrade: Coral bedrock; and residual red clay, medium to high plasticity, 0-6' thick between coral outcrops. General: Terrain: Flat coastal plain on coral reef, surrounded by coconut grove & rain forest. Maximum monthly rainfall: 21" in December. Water table: About 8' depth. Use: Motorcade	-	Base course: 1/2 - 1' thick Subgrade: 0 - 6' thick	Crushed coral and clay Red clay	CH	-	0	2	8	90	75	47	2.98	31	93	8	Low	-
(d) Bana Bana	10 39 N 122 56 E	F	Surface: Rolled crushed rock, no binder. Base: Hand-placed river cobbles up to 12" diam. Voids filled with crushed rock & sand. Subgrade: A mixture of clay, sand, & silt. Upper several feet cobbled. South runway end; fairly coarse beach sand at surface. General: Terrain: Gently rolling grassland with fair drainage. Maximum monthly rainfall: 7" in October. Water table: 3 1/2' depth. Condition & use: Built early 1945 & used by P & L. B. Now used by commercial planes. Much of crushed rock surfacing gone.	Northern 2/3 of runway Northern 2/3 of runway Southern 1/3 of runway -	Upper subgrade: 0 - 1' thick Lower subgrade: 0 - 1 1/2' thick Subgrade: 0 - 1' thick Selected fill: 1' thick	Gray sandy clay Gray clay Gray & tan silty sand Cobbles & sand-clay	CH CH SM -	-	0	6	26	68	59	37	2.69	15	107	-	-	-
(e) Caba Laba	10 20 N 123 34 E	B	Surface: Rolled clay-coral. Base: Crushed coral & clay mix, 4-6" thick. Subgrade: 0-10" black highly plastic organic clay over 0-24" brown medium plastic clay over brown clay of low plasticity containing varying amounts of sand & gravel. General: Terrain: Gently sloping pleasant plain; grassland & cultivated fields. Maximum monthly rainfall: 7" in October. Water table: About 3' depth. Condition & use: Built early 1945 & used as P & L base. Light traffic now by civilian plane. Excellent dry weather surface, but very slippery & ruts easily when wet.	-	Base course: 4 - 6" thick Upper subgrade: 0 - 1 1/2' thick Intermediate subgrade: 0 - 2' thick Lower subgrade: 1 1/2 - 3' depth	Crushed coral Black gravelly sandy clay Intermediate Gray sandy clay Sandy clay	CF CL CL CL	3/4 3/8 -	49 27 -	14 15 -	34 19 -	74 57 -	44 39 -	20 19 -	2.66 2.79	16 113	5	High	-	-
Open (Marian Islands)	10 17 N 124 00 E	B	Surface: Compacted crushed coral. Base: Coral rocks, 8-10" diam., hand-placed by Japs. About 1/3 removed by U.S. & replaced with well-graded crushed coral. Subgrade: Massive coral over entire area. General: Terrain: Gently rolling grassland near center of island. Maximum monthly rainfall: 7" in October. Water table: About 5' depth. Use: Operated after capture early 1945. Turned over to Japs after cessation of hostilities.	-	Base course	Crushed coral	-	-	3	11	17	69	59	37	2.79	16	113	5	High	-

TABLE 3. SUMMARY OF AIRFIELD TEST DATA (Cont.)

AIRFIELD		SAMPLE		SOIL TESTS																					
Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classi- fication Symbol	Grain Sizes						Atterberg Limits		Spec. Grav. γ_s		Mod. AASD Compaction		CR	Swell				
								Max. Gravel Sieve No.	% Gravel > No. 10	% Sand No. 10 to 40	% Fines No. 40 to 200	LL	PI	LL	PI	2.65	2.70	2.65	2.70						
(f) Laysan	11 06 N 155 01 E	MF	Surface: Steel mat on coral sprayed with penetration asphalt. Base: 6" thickness crushed coral, partially weathered & containing yellowish brown clay. Subgrade: Fine poorly-graded beach sand. General: Terrain: Flat coastal plain; grassland, erodible sand soil. Bottom mostly rainfall; 14" in December (Water table: About 8" depth). Note: Built late 1944; F & M base during Campaign. Not abandoned.	-	Typical base coarse	Crushed coral	-	1-1/2	59	13	25	3	88	13	8	2.62	-	-	88	13	8	2.62	-	-	
Truk	11 11 N 125 01 E	EB	Surface: Steel mat on coral sprayed with penetration asphalt. Base: 6" to 8" thick coral (the greater depth to meet fill requirements). Subgrade: Thin clay layer at surface overlying fine poorly-graded beach sand. General: Terrain: Flat coastal bar surrounded by water on 3 sides; grassland; erodible soil; surface drainage problem due to low elevation. Bottom mostly rainfall; 14" in December (Water table: About 5-7" depth). Note: Former commercial field enlarged by Japs & later by U.S. Considerable traffic of all types.	-	Typical base coarse; 1" to 1 1/2" thick	Crushed coral	-	1/2	46	12	20	2	88	12	8	2.75	-	-	88	12	8	2.75	-	-	
Bay	10 59 N 125 02 E	MB	Surface: MF Base: Very thin layer of beach-run river gravel. Subgrade: 1/2-1' of brown sandy clay over more plastic black clay. General: Terrain: Flat flood plain; grassland. Bottom mostly rainfall; 14" in December (Water table: About 5" depth). Condition: Wet; Advanced fighter base. Note: Abandoned. Surface uneven & rutted.	-	Upper subgrade Lower subgrade	Brown sandy clay Black sandy clay	ML ML	- -	0 0	3 4	25 29	69 67	82	13 17	15	2.70 2.67	26 23	97 101	7 7	Low Low					
Dales	10 57 N 125 02 E	MB	Surface: MF sprayed with penetration asphalt. Base: 6-12" thickness beach sand & river gravel. Cobble up to 8" diam. used. Subgrade: Highly plastic yellow alluvial clay. General: Terrain: Flat coastal & flood plain; natural drainage; grassland. Bottom mostly rainfall; 14" in December (Water table: About 5" depth). Condition: Wet; Built by Japs; enlarged by U.S. & used as F & M base. Surface rough & uneven due to poor subgrade.	-	Typical base coarse Typical sub-grade	Sandy gravel Brown clay	GM MH	1 -	80 2	11 6	9 10	0 82	0	70	31	2.91 2.65	- 29	- 91	- 7	- Low					
(d) Saipan Okinawa	11 02 N 125 03 E	EB	Surface: Penetration asphalt on coral. Base: Coral subgrade certified & recompact. Subgrade: Massive coral, somewhat weathered at surface & mixed with yellow clay. General: Terrain: Flat, but drained satisfactorily; surrounded by rain forests. Bottom mostly rainfall; 14" in December (Water table: About 7" depth). Note: Built late 1944. Used as F & M base. Previously naval air base. Capacity: all types. Traffic: 75 planes per day.	-	Typical base coarse	Coral with yellow clay	-	1	68	6	10	16	88	16	8	2.66	-	-	88	16	8	2.66	-	-	

TABLE 31. SUMMARY OF AIRFIELD TEST DATA (Cont.)

Group 31: Pacific Islands

AIRFIELD		SAMPLE										SOIL TESTS											
Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classi- fication Symbol	Grain Sizes					Atterberg Limits					Mod. ASD					
								Max. Gravel Size in.	Gravel > No. 10 Sieve	Sand 10 to 40 Sieve	Coarse Sand 40 to 200 Sieve	Fine Sand < No. 200 Sieve	Plasticity Limit %	Atterberg Limits %	Spec. Grav., G _s	Opt. Compaction	Max. Density, P _d	Spec. Grav., G _s	Opt. Compaction	Max. Density, P _d			
(h) Midway Island (Midway)	07 37 N 154 03 E	MB	Surface: Steel mat over asphalt base; 3-6" thickness of coarse beach gravel subgrade; About 18" brown silty sand over coarse poorly-graded volcanic sand. General: Terrains: Flat coastal terrace; low-lying coconut plantations. Monthly rainfall: 4" average June thru December. Use: Advanced F & B base, now on reserve status.	-	Upper subgrade	Brown silty sand (flood plain)	SM	-	6	24	40	22	NP	NP	2.69	17	102	85	102	85	Low		
				-	Lower subgrade	Black silty sand (volcanic)	SM	3/8	13	37	40	10	NP	NP	2.79	22	84	31	22	84	31	Low	
Marot	06 56 N 124 04 E	MB	Surface: Asphalt, using beach gravel for aggregate. Base: Sand-placed coral rubble bound with pulsed crushed coral, 6-12" thick. Subgrade: Generally 1-5' black organic clay overlying highly plastic yellow clay. At west end a reddish-brown silt up to 3-1/2' thick covers these soils. General: Terrains: Flat coastal plain; rice paddies. Monthly rainfall: 4" average June thru December. Use: Advanced F & B base, now on reserve status.	-	Asphalt aggregate	Samples missing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
				-	Base course	Crushed coral	-	1/4	10	13	21	56	28	9	2.66	-	-	-	-	-	-	-	
				East end of runway	1-5' thick	Black clay	CH	-	0	0	7	93	72	46	2.58	22	100	4	22	100	4	High	
					Upper subgrade	Brown clay	ML	-	0	2	17	81	41	13	2.66	12	112	6	12	112	6	Low	
				-	0-3-1/2' thick	Brown & tan clay	CH	-	0	0	8	92	72	46	2.72	17	106	4	17	106	4	High	
(2) PALAU GROUP: Palau Island (Palau)	06 50 N 134 14 E	MB(1)	Surface: Roll of coral base & subgrade; Coral bedrock. General: Terrains: Flat coastal plain; well-cultivated artificially; grassland surrounded by rain forest & mangroves. Use: Built after capture & used as bomber base. Now a permanent level air base.	Coral pit	Surfacing	White coral	-	3/4	66	20	9	5	NP	NP	-	13	113	78	13	113	78	Low	
(3) ANIMALLY ISLAND: Animally Island (Animally)	08 03 S 147 26 E	MB	Surface: Rolled coral base & subgrade; Coral bedrock. General: Terrains: Flat coral reef; surrounding area covered by rain forest. Use: Built after capture & used as bomber base. Now a permanent level air base.	Coral pit	Surfacing	White coral	-	1/2	51	30	15	4	NP	NP	-	16	110	94	16	110	94	Low	
(4) NEW GUINEA AREA: New Guinea Island (New Guinea)	01 10 S 156 05 E	VB	Surface: Rolled coral base & subgrade; Coral bedrock. General: Terrains: Flat coastal area surrounded by coconut groves & rain forest. Use: Built after occupation of island. Was one of major airfields in GFA. Now under Dutch control.	Coral pit	Surfacing	Coral	-	-	2	21	29	46	NP	NP	2.56	14	111	52	2.56	14	111	52	Low

TABLE 3: SUMMARY OF AIRFIELD TEST DATA (Cont.)

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TABLE 3: SUMMARY OF AIRFIELD TEST DATA (Cont.)

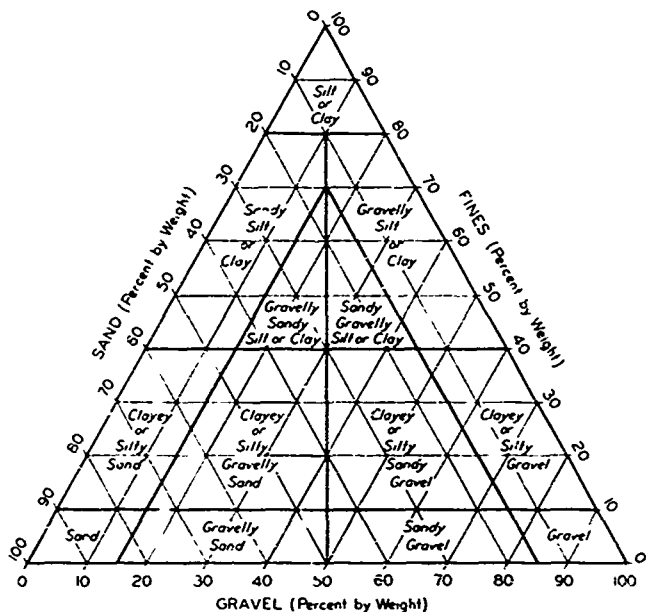
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TABLE 3: SUMMARY OF AIRFIELD TEST DATA (Cont.)

Group F: Hawaiian Islands, Alaska, Aleutians

AIRFIELD			SAMPLE											SOIL TESTS										
Name and Location	Latitude and Longitude	Field Class.	Airfield Description	Location	Material	Description	Classification Symbol	Grain Sizes										Atterberg Limits			Mod. ASHED Compaction		CPR	Swell
								Max. Gravel Size In.	Gravel > No. 10 Sieve	Coarse Sand 40 to 200 Sieve	Fine Sand 40 to 200 Sieve	Fines	LL	PL	Sh	Opt. V %	Max. V %							
(b) <u>Atka Island</u> <u>Adak</u>	52 15 N 176 15 W	T	Surface: Steel mat runway Base: None General: Little traffic on field after 1945	South end runway Center of runway North end runway	Subgrade Subgrade Subgrade	Black fine sand Black fine sand Black fine sand	SP EP SP	- - -	0 0 0	13 9 15	80 61 75	7 10 10	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -			
(c) <u>Adak Island</u> <u>Adak</u>	51 53 N 176 39 W	VB	Surface: 5" asphaltic conc. (aggregate crushed andesite porphyry, 1-1/4" max. size) Base: 12" crushed andesite porphyry (1" max. size) General: Moderate traffic (MB, V) with good performance	- - -	Subgrade Typical subgrade Typical base course	Brown fine sand Gray sandy silt Crushed rock	SP ML GM	- - 3	0 8 87	8 21 3	79 23 10	13 43 0	- - -	15 42 -	110 69 -	- - -	- - -	- - -	- - -	- - -	- - -			
(d) <u>Adak Island</u> <u>Adak</u>	52 44 N 176 08 W	VB	Surface: 5" asphaltic concrete Base: 7" crushed rock (2" max. size) Subgrade: Fill composed of sand, beach gravel & pitrun stone. Trenches 1 to 8' thick overlying sand was stripped to 6" below subgrade elevation General: Fair traffic (F, MB, B, V)	- - -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -			

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NOTES

- 1 Identification based on following grain size ranges
 Gravel 3 in. to no. 10 sieve (20 mm)
 Sand No. 10 (20 mm) to no. 200 (0.075 mm)
 Fines (silt or clay) Below no. 200 (0.075 mm)
2. Soil is called "silt" or "clay" based upon Atterberg limits values of minus 40 mesh fraction as follows
 Silt LL 28 or less, and PI 6 or less
 Clay LL over 28 or PI over 6.
- 3 Sieve sizes are U S Standard

SOIL TRIANGLE

CLASSIFICATION OF SOILS

MAJOR DIVISIONS		LETTER	NAME
COARSE GRAINED	GRAVEL	GW	Gravel or Sandy Gravel, well-graded
	AND	GP	Gravel or Sandy Gravel, poorly-graded
	GRAVELLY	GM	Silty Gravel or Silty Sand: Gravel
	SOILS	GC	Clayey Gravel or Clayey Sandy Gravel
FINE GRAINED	SAND	SW	Sand or Gravelly Sand, well-graded
	AND	SP	Sand or Gravelly Sand, poorly-graded
	SANDY	SM	Silty Sand or Silty Gravelly Sand
	SOILS	SC	Clayey Sand or Clayey Gravelly Sand
FINE GRAINED	LOW PLASTICITY	ML	Silts, Sandy Silts, Gravelly Silts, or Diatomaceous Soils
		CL	Lean Clays, Sandy Clays, or Gravelly Clays
		OL	Organic Silts or Lean Organic Clays
FINE GRAINED	HIGH PLASTICITY	MH	Micaceous Clays or Diatomaceous Soils
		CH	Fat Clays
		OH	Fat Organic Clays
PEAT AND OTHER FIBROUS ORGANIC SOILS		Pt	Peat, Humus, and other Organic Swamp Soils